

## Chapter 16:

# The Special Senses

### *Chapter objectives:*

1. Describe the structures of the Special Senses
2. Explain the pathways of sound in the ear and light in the eye
3. Identify, describe, and discuss the receptors and neural pathways involved in each of the five special senses

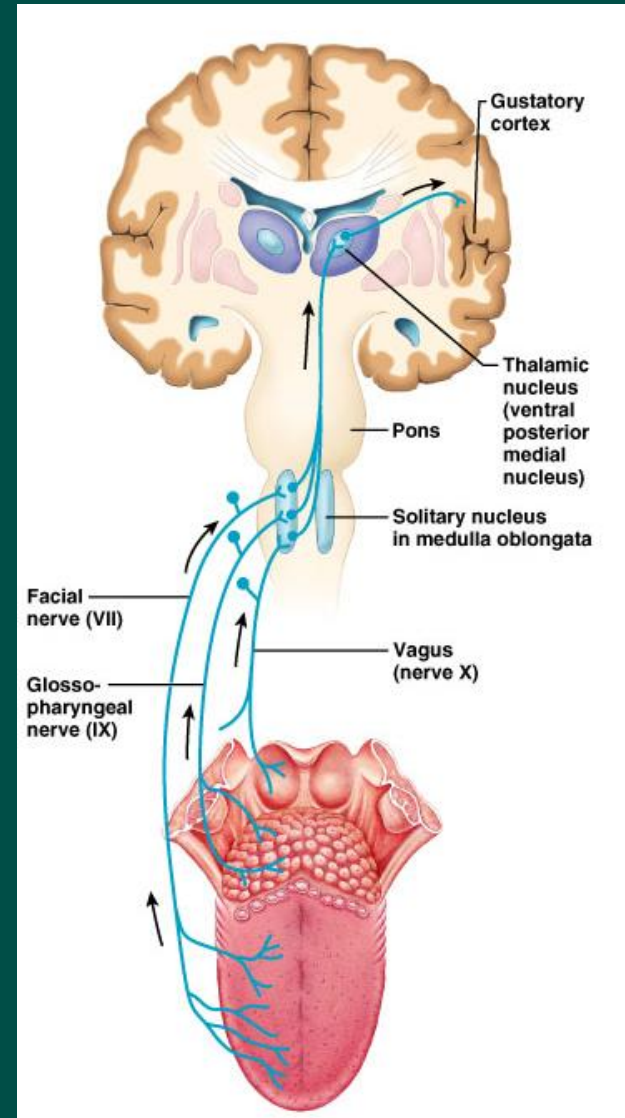
### Chemical Senses

- 
1. Taste
  2. Smell
  3. Sight
  4. Hearing
  5. Touch (Chapt 14)

# The Chemical Senses:

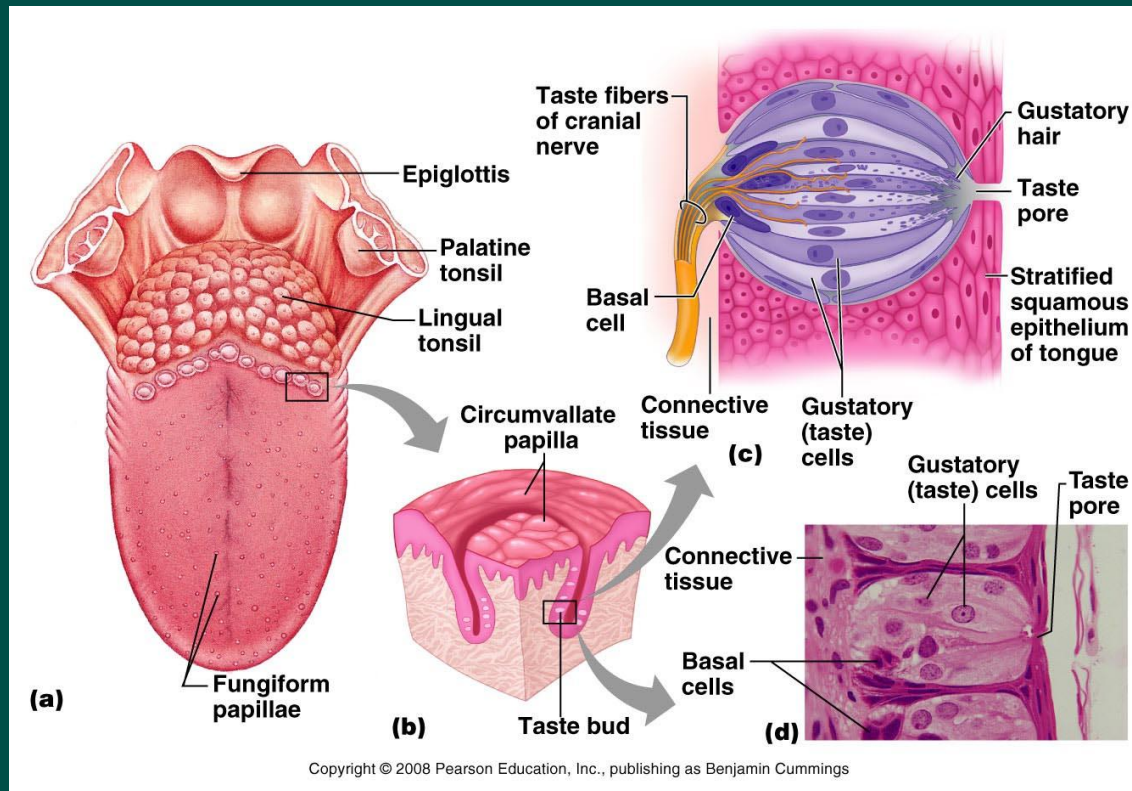
## 1. Taste

- Chemoreceptors in **Taste Buds**
  - Mostly in papillae on the tongue
    - Circumvallate, fungiform
    - Each has groups of **gustatory cells**
- Sweet, Sour, Salt, Bitter, Umami
- CN VII and IX to medulla oblongata



# The Chemical Senses:

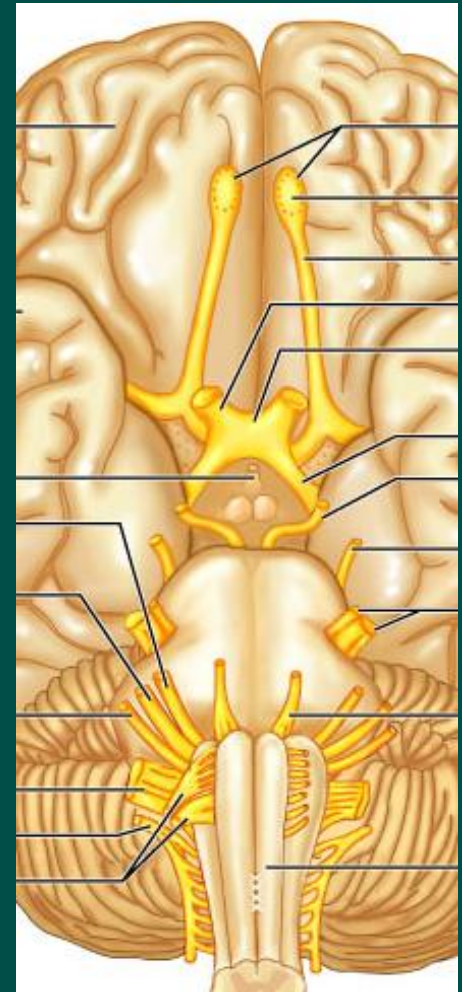
## 1. Taste



# The Chemical Senses:

## 2. Smell

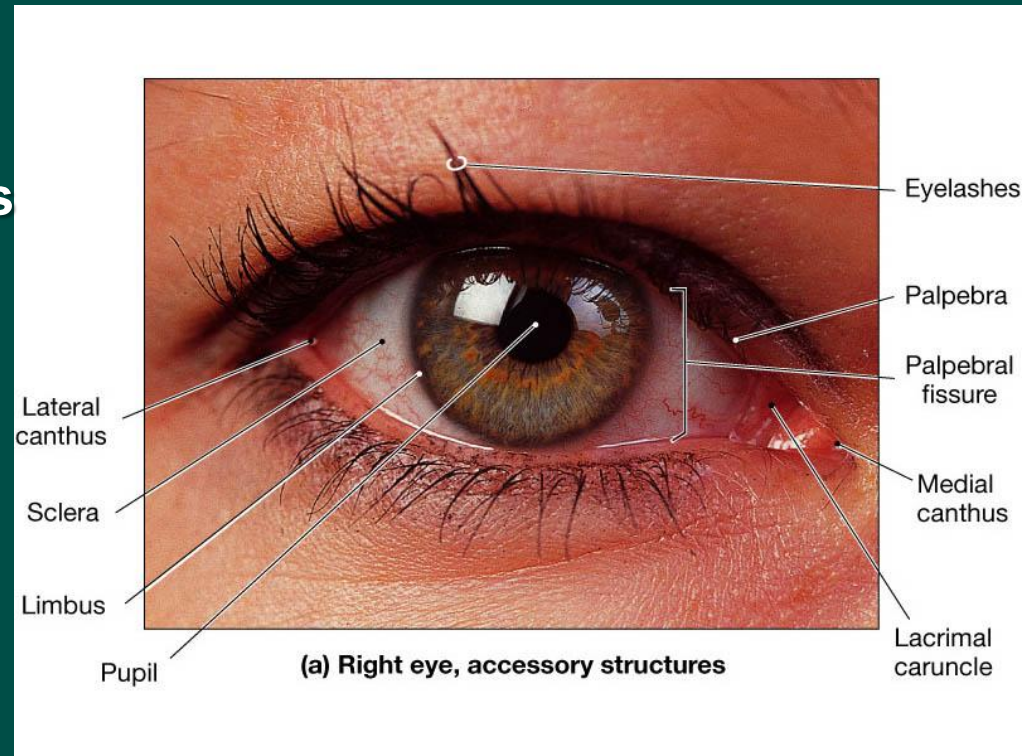
- Olfactory Epithelium (CN I)
  - Receptors in pseudostratified epithelium in nasal conchae and septum
- Filaments from OE protrude through the Cribriform Plate of ethmoid bone
  - CN I runs to the Olfactory Bulb, and to the olfactory cortex of the cerebrum



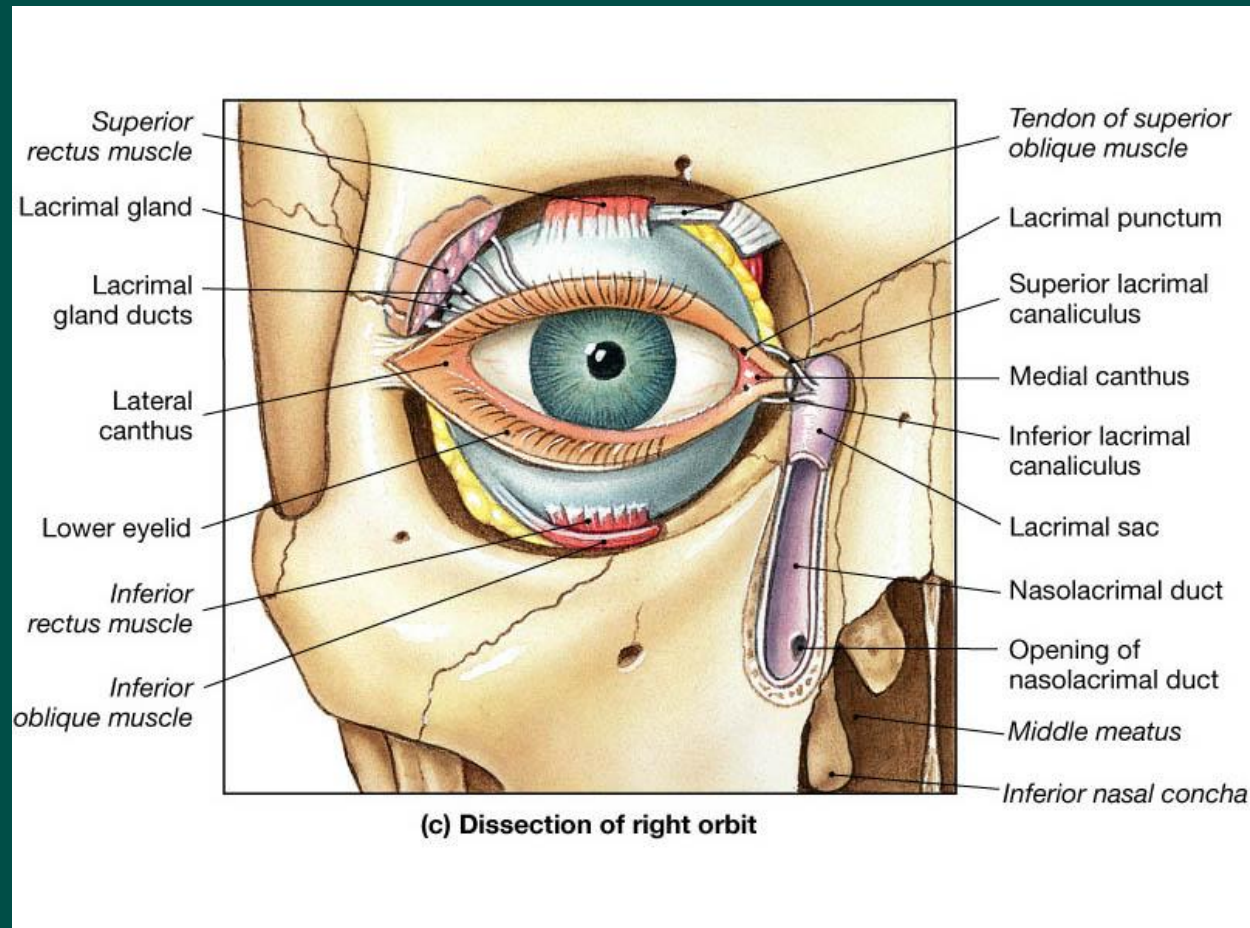
# Vision (Eye and Accessories)

## Factoids:

- Most dominant sense
  - 70% of the body's receptors are in the eyes
  - 40% of cortex dedicated to visual processing
  - Most metabolically active tissue
- Medical careers:
  - Optician
  - Optometrist
  - Ophthalmologist

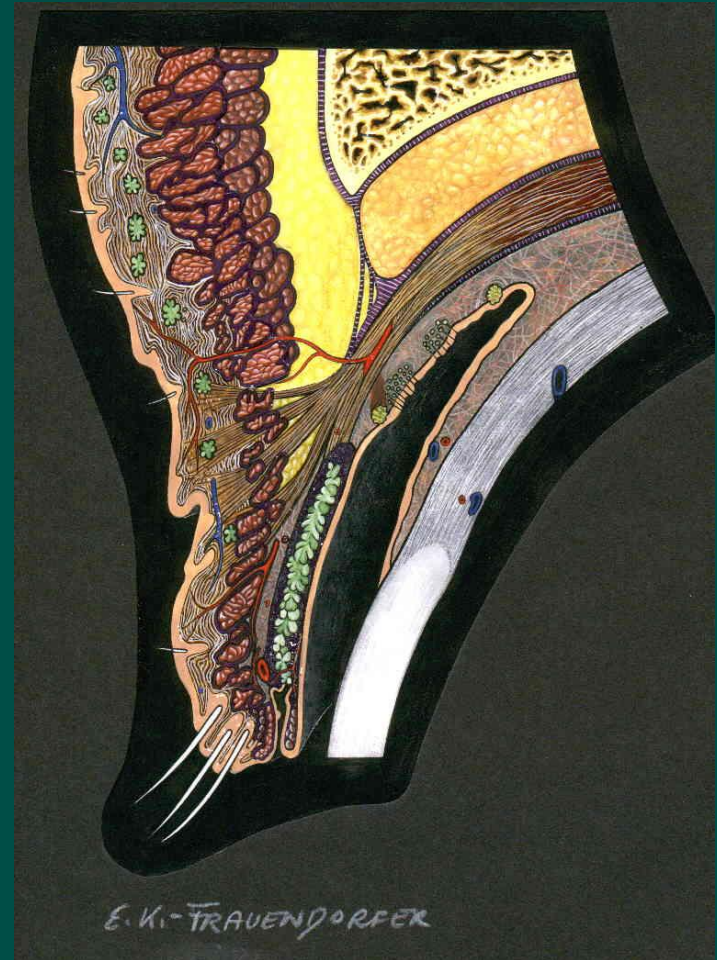


# Dissected View



# Palpebrae = Eyelids

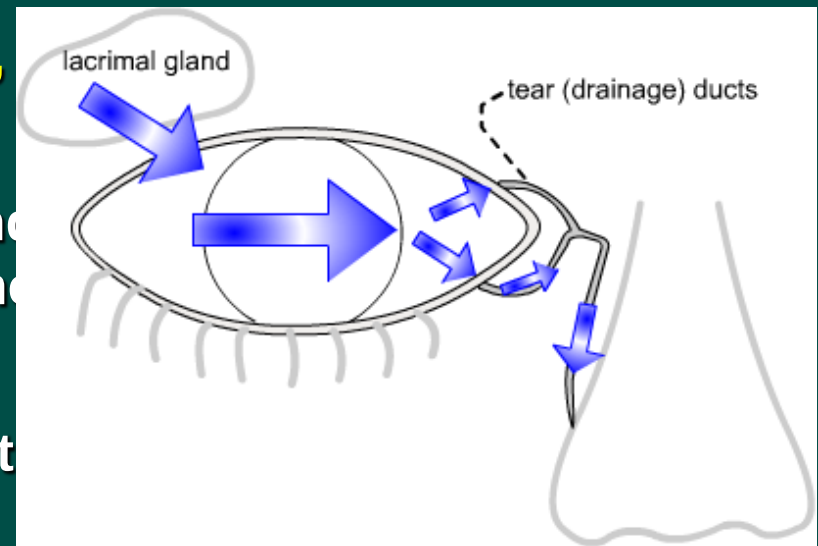
- Continuation of skin
- Eyelashes
- Tarsal Plate of Hyaline C.
- **Tarsal (Meibomian) glands** on inner margin of lid
  - The oily portion of the tear film
  - Swollen gland = chalazion
- **Conjunctiva** (= mucous membrane)
  - Palpebral or Bulbar
  - Over cornea very thin (5-7 cells thick)
  - Conjunctivitis (pink eye)



Chalazion

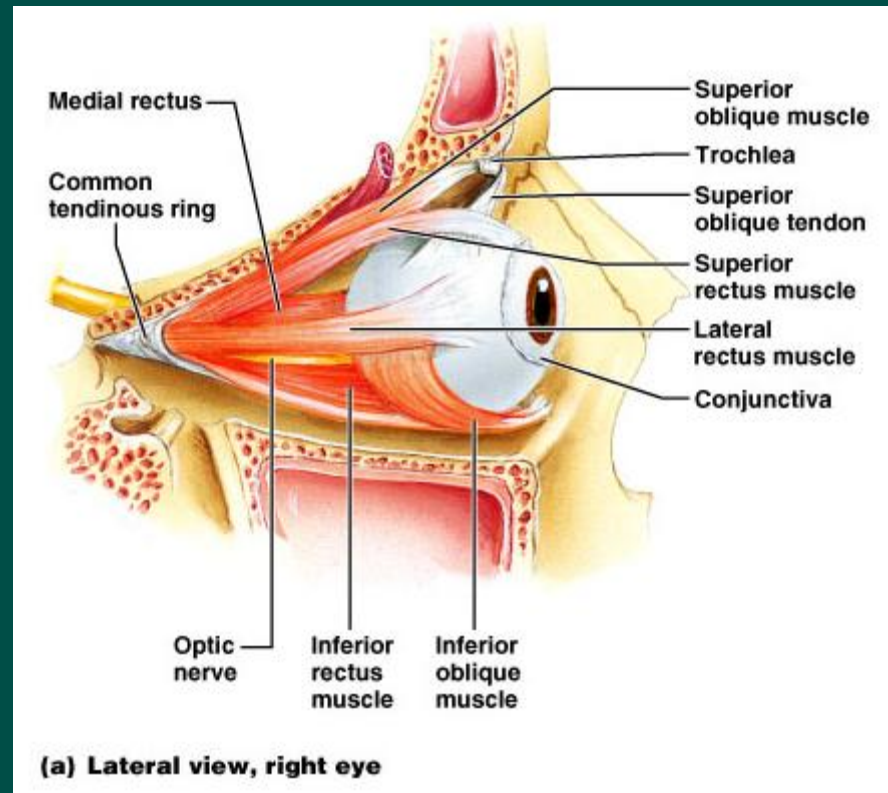
# Lacrimal Apparatus

- **Lacrimal gland** with several ducts - superior and lateral to eye
  - Secretion contains **water, lysozyme, Ab, mucus**
- **Lacrimal puncta** (superior and inferior) - holes next to the medial canthus to drain tears
- **Nasolacrimal duct** - empties to nasal cavity



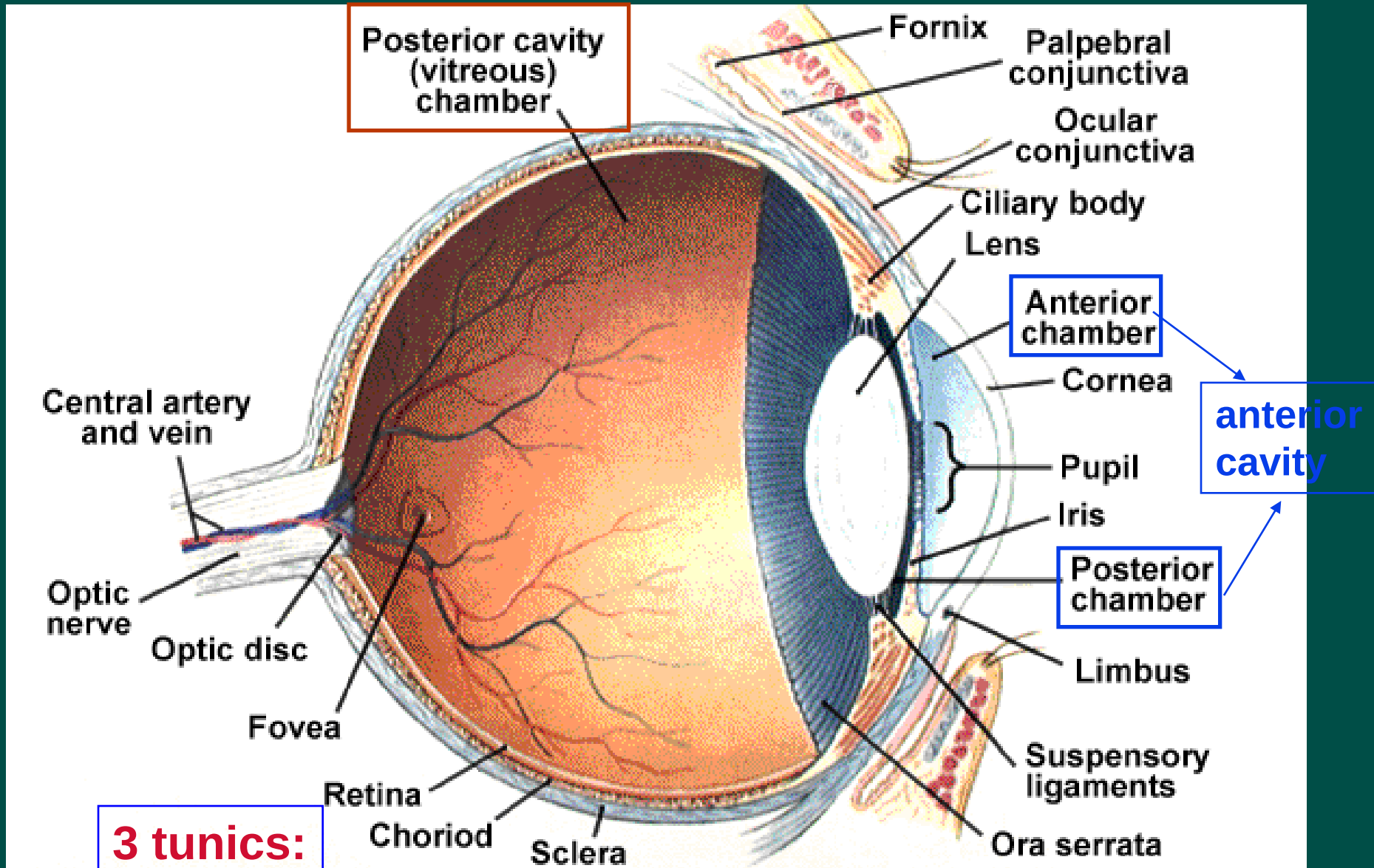
# Extrinsic Eye Muscles (review)

- 4 rectus muscles
  - Lateral (CN VI)
  - medial, superior, inferior (CN III)
- 2 obliques
  - Superior (CN IV)
  - Inferior (CN III)



# The Globe (Eyeball)

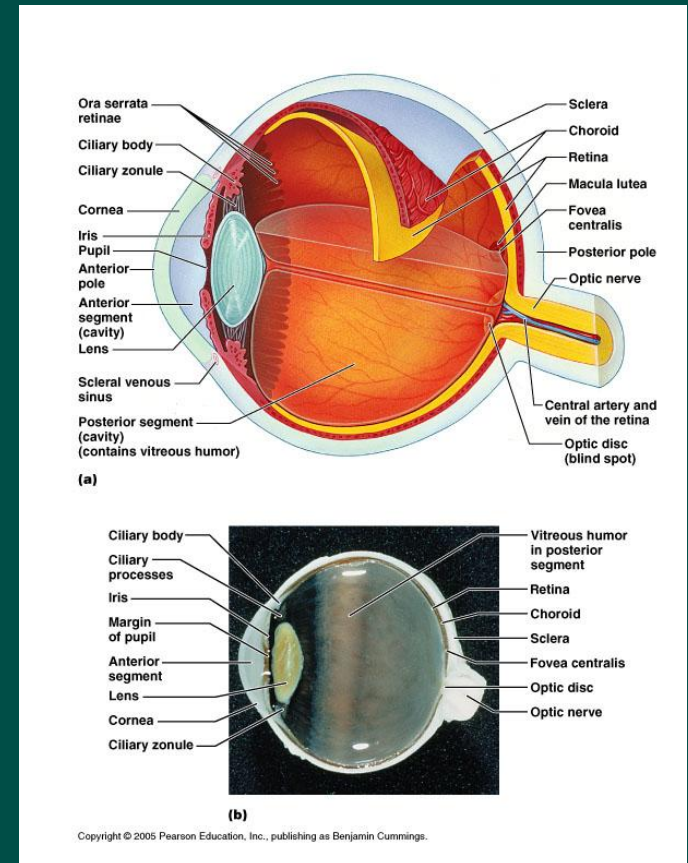
Learn all of this chart!



# The Three Layers (tunics):

## 1. Fibrous Tunic (tough outer layer)

1. **sclera** - white part of fibrous tunic
2. **cornea** - transparent anterior part
  1. Avascular: nutrition via diffusion
  2. pain receptors
  3. Layer of noncornified stratified squamous epithelium
3. **limbus** - boundary between the above



# The Three Layers (tunics):

## 2. Vascular Tunic (= Uvea)

### 1. choroid –

1. heavily vascular
2. posterior aspect

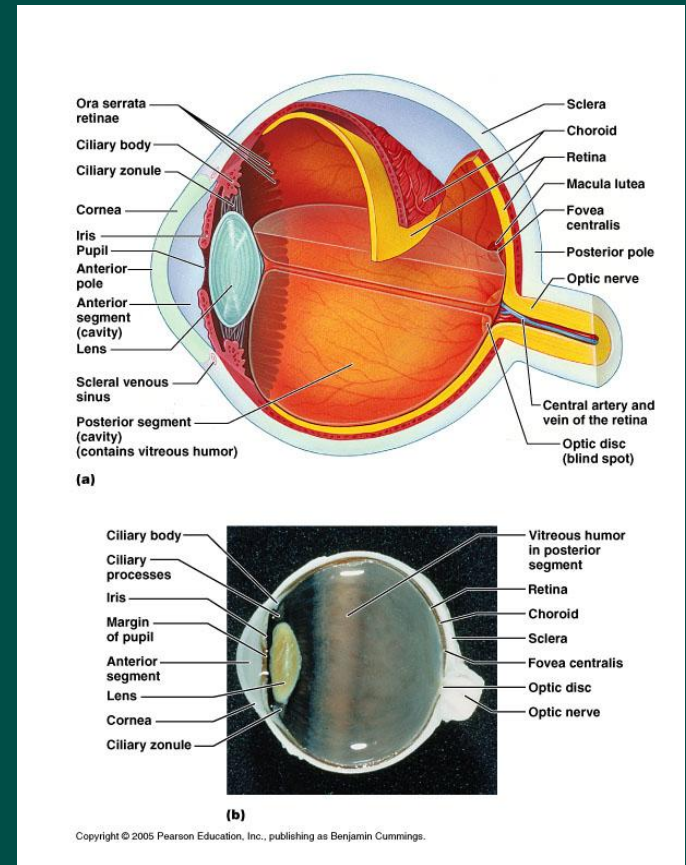
### 2. iris with pupil – inner

### 3. sphincter and outer radial muscles

### 4. ciliary body – (ciliary m.) attached to

### 5. Radial suspensory ligaments (ciliary zonule)

1. regulates focus of lens



# The Three Layers (tunics):

## ■ 3) The Sensory Tunic

AKA Nervous Tunic, retina

Outer layer pigmented - inner layer  
**photoreceptors  $10^6$**

a) rods - black/white vision, dim light

b) cones - color vision, intense light

Bipolar cells - synapse with rods and cones

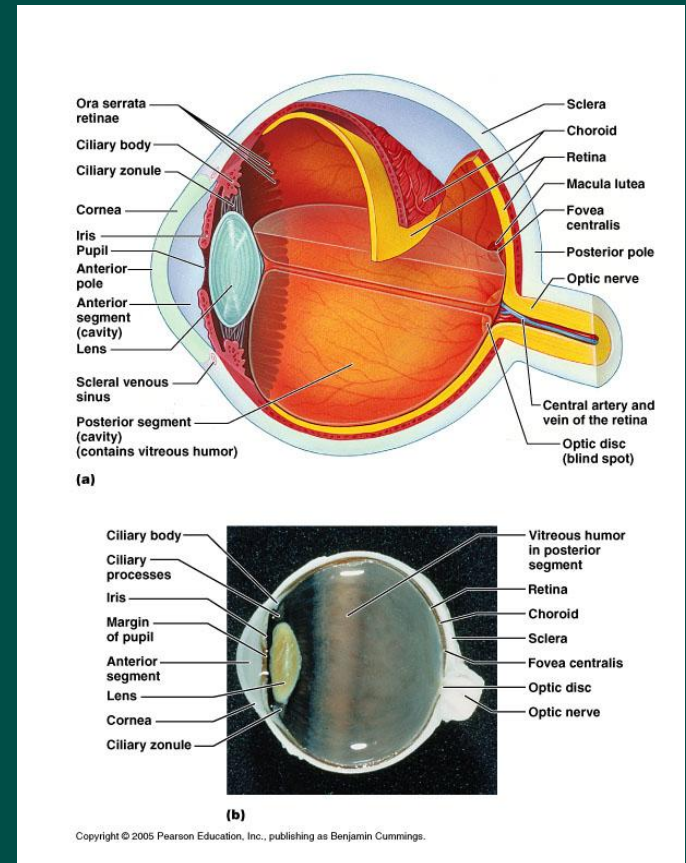
Ganglion cells - synapse with bipolar cells

Ora serrata - anterior edge of retina

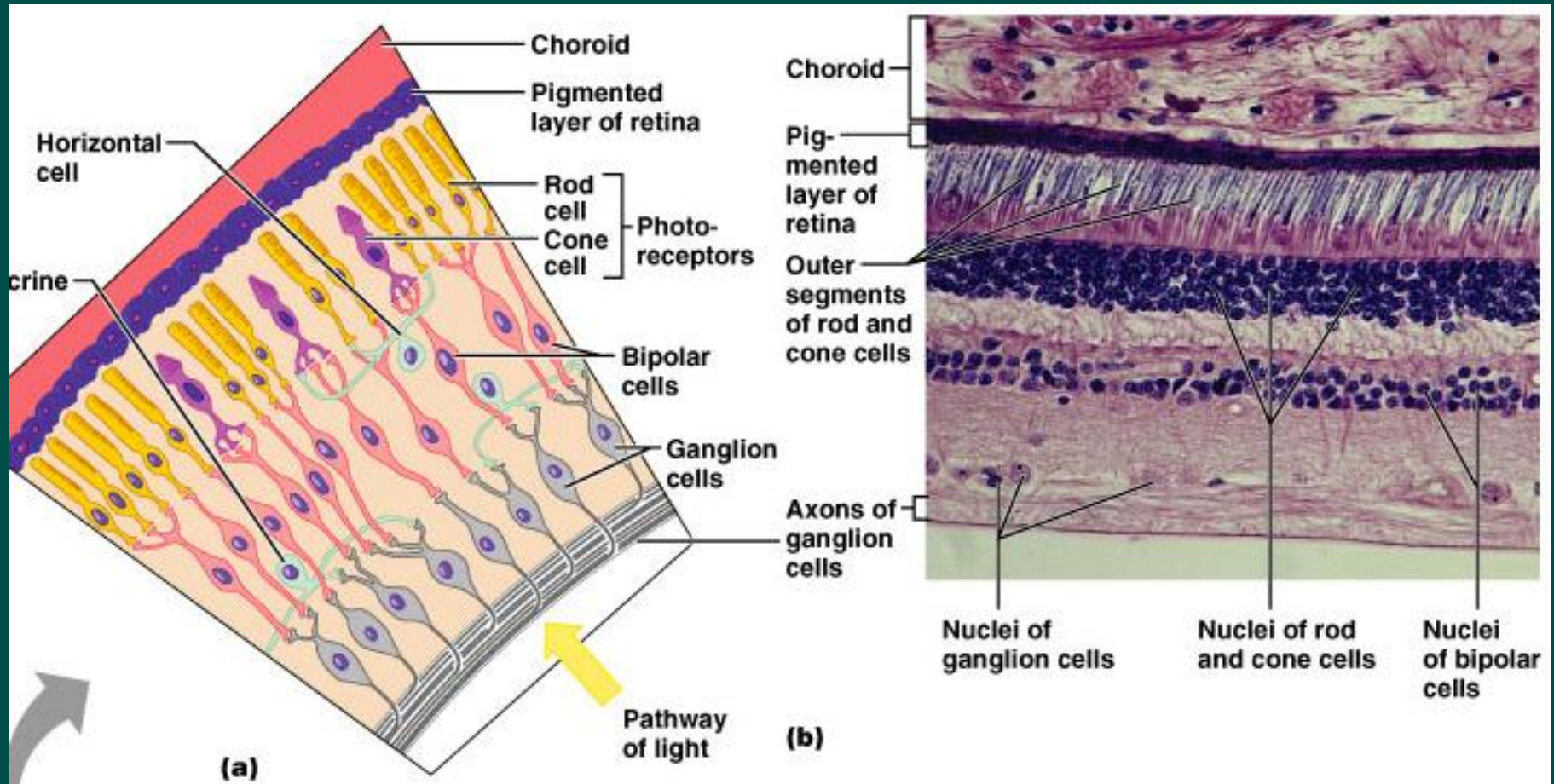
Macula lutea – fovea centralis - all cones, best vision

Optic disc – blind spot, where optic nerve exits eye

Optic nerve (CN II)



# Retina



# Retina

- **Photoreceptors**
  - Infolding membranes contain photopigments
- **Rods**
  - Most numerous
  - Non-acute vision
- **Cones**
  - Concentrated in macula
  - Color vision –red, green blue

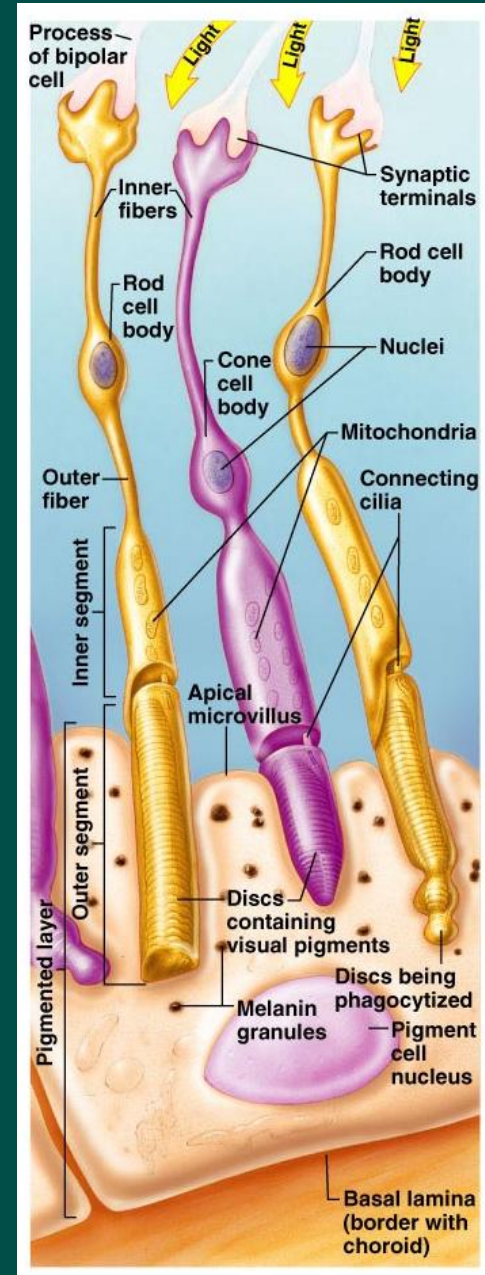
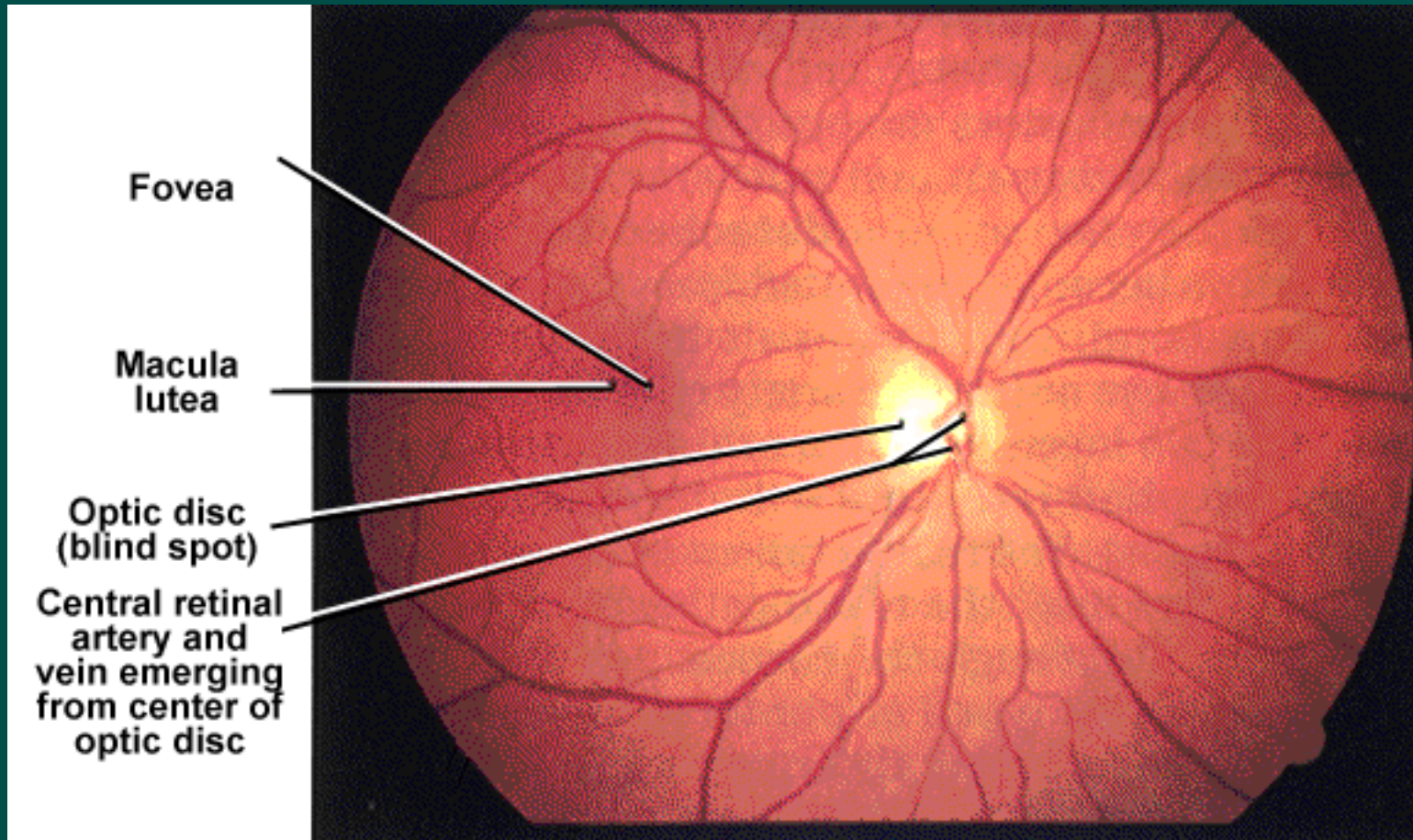


Fig 16.10

# Eye Fundus:



**Age Related Macular Degeneration**

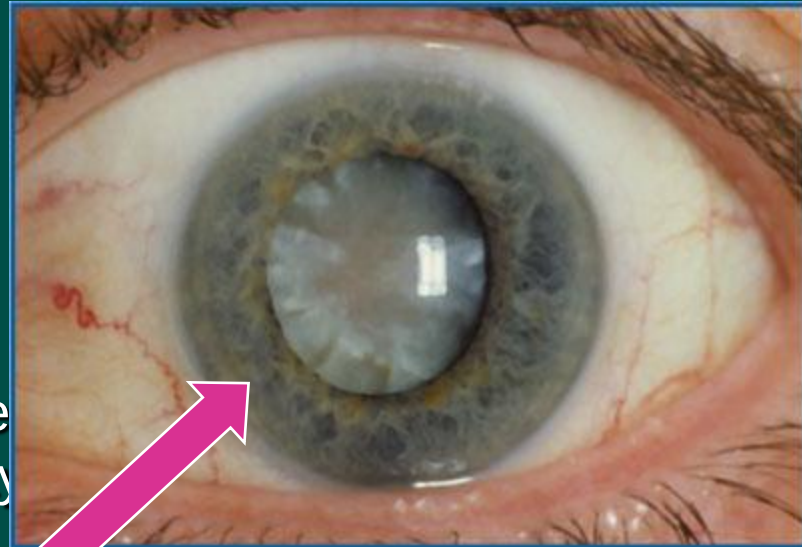
# Chambers of the Eye

- **Posterior Segment**
  - **Vitreous Humor**
- **Anterior Segment—filled with aqueous humor**
  - **Anterior chamber = between iris and cornea**
  - **Posterior Chamber = between lens and iris**
- **Posterior cavity with vitreous humor**



# Vision Terminology p 494

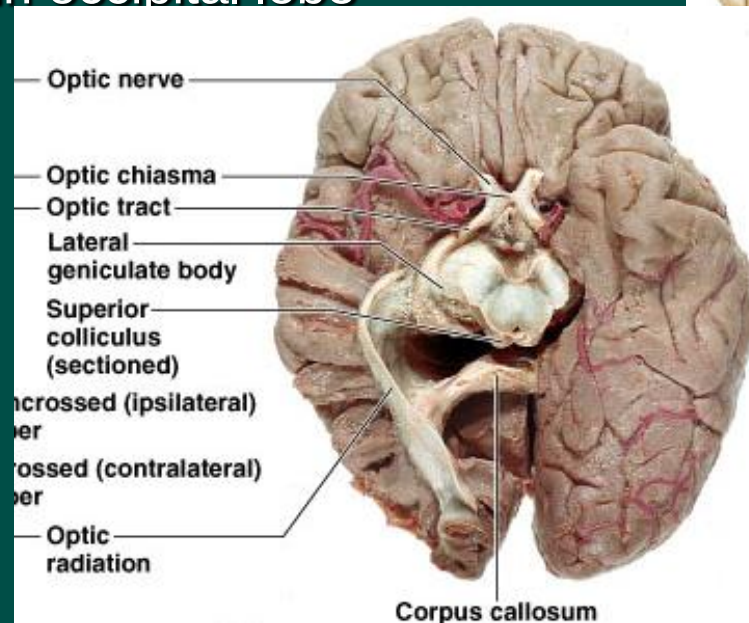
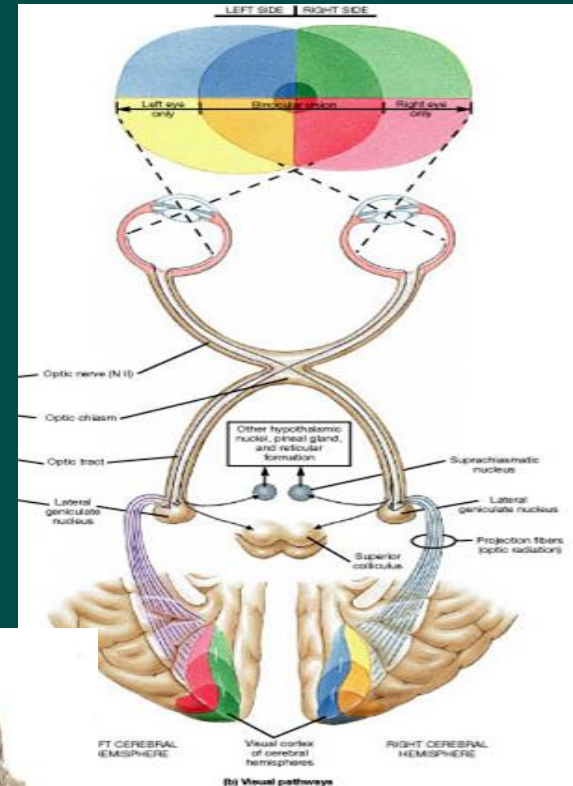
- Emmetropia = Normal vision
- Hyperopia = Farsightedness
- Myopia = Nearsightedness
- Presbyopia = Poor close-up vision with aging
- Astigmatism = Abnormal shape of the surface of the lens and/or cornea
- Cataract = abnormal crystallization of the lens, common in diabetes, injury, heredity
- Amblyopia = Poor vision in a normal eye (CNS defect)



# Visual Pathway

Optic chiasma - optic nerves partially cross (right side of the field of each eye combining and going to the lateral geniculate on the right, those from the left to the left)

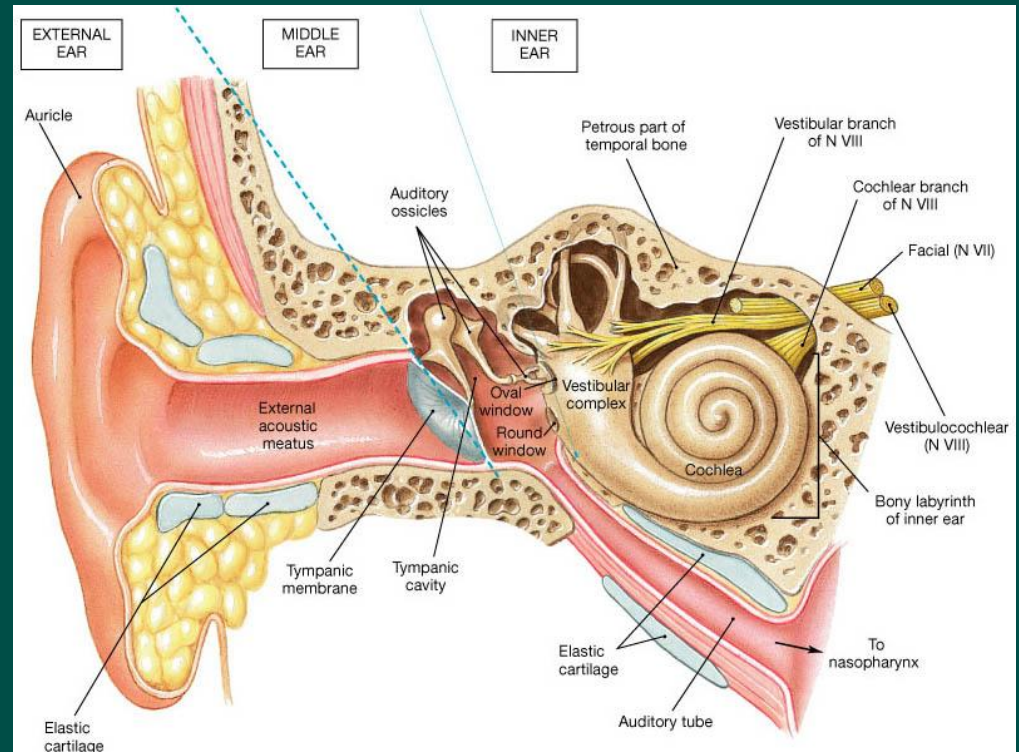
To superior colliculus and thalamus and visual cortex in occipital lobe



# The Ear

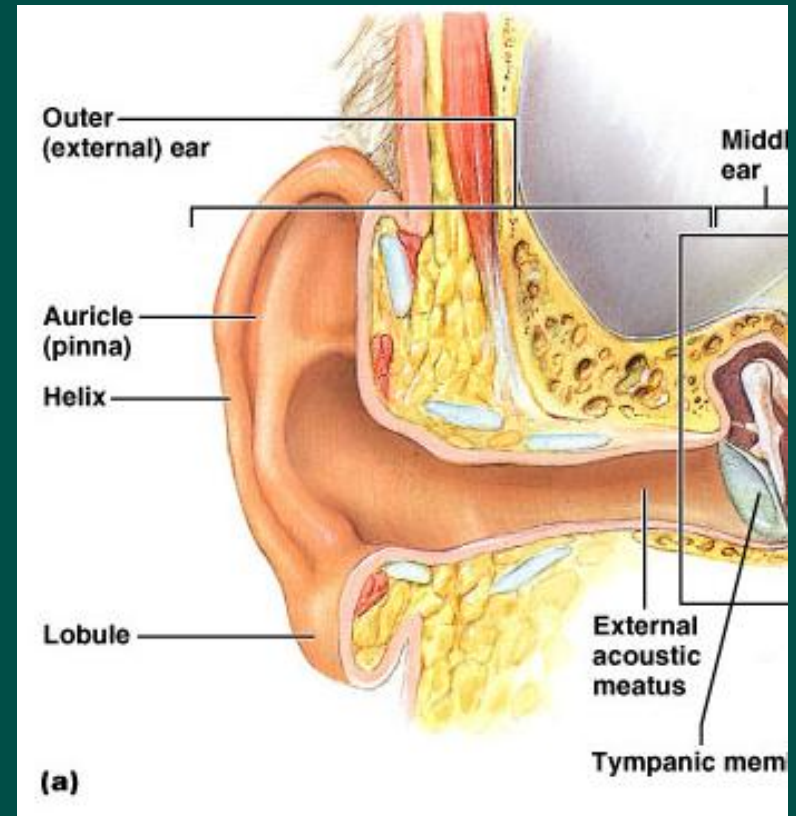
Hearing  
Balance (equilibrium)  
CN VIII

1. External ear
2. Middle ear
3. Inner ear



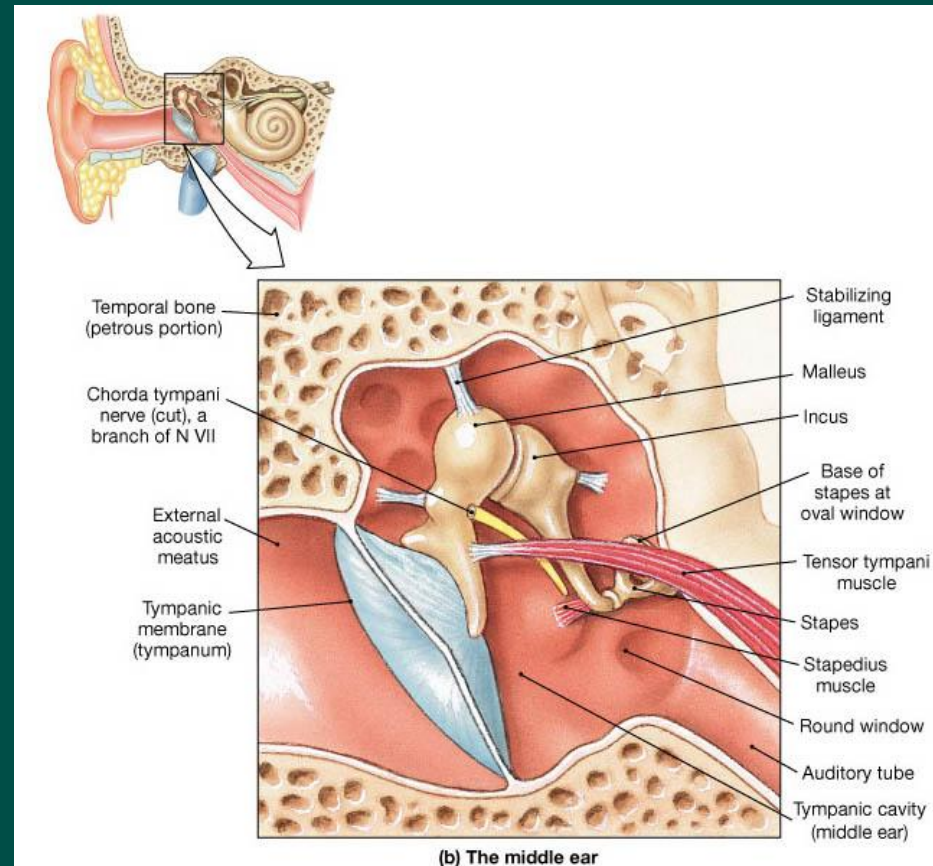
# 1. External Ear

- Auricle or Pinna
  - Elastic Cartilage
- External ear canal
  - Through the external acoustic meatus
  - Ceruminous glands
    - Cerumen (ear wax)
  - In what bone??



## 2. Middle Ear

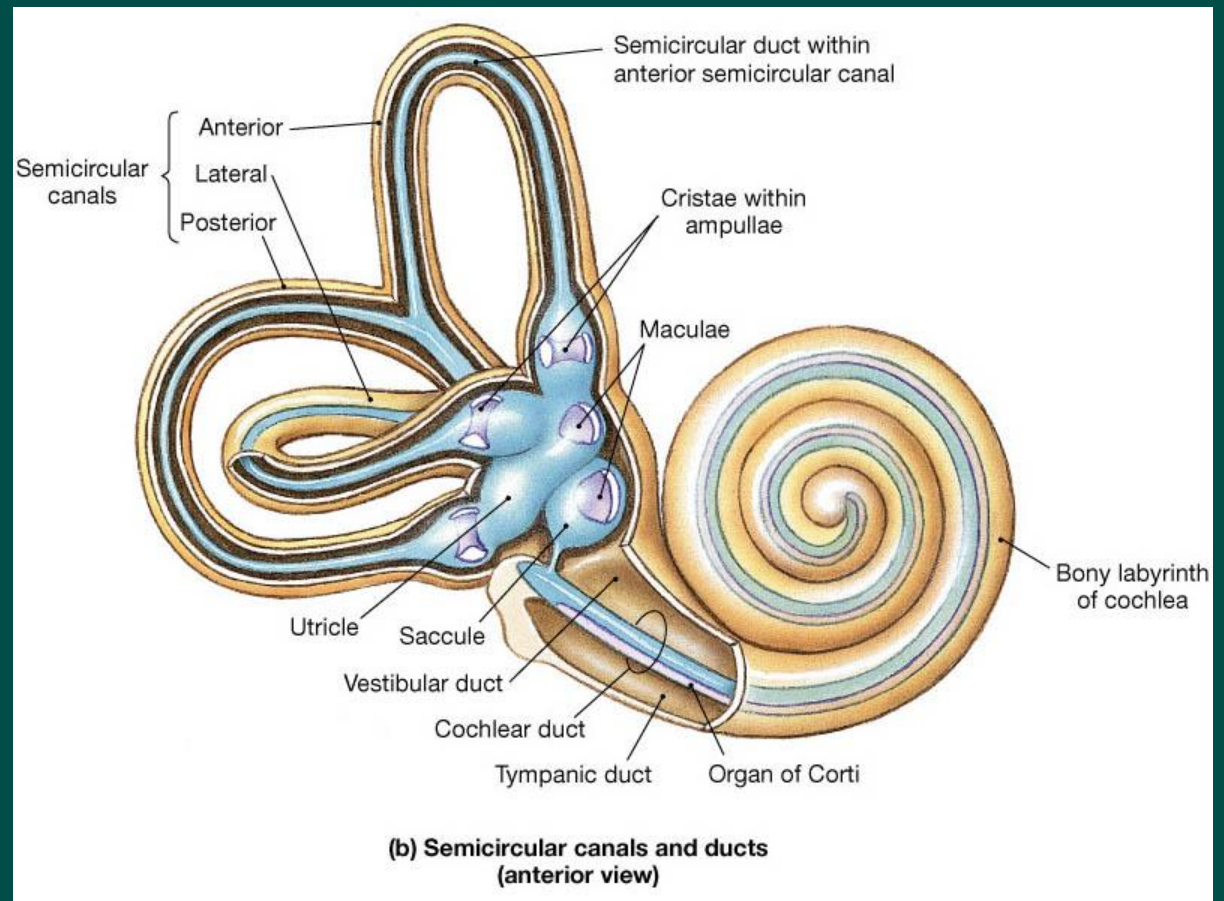
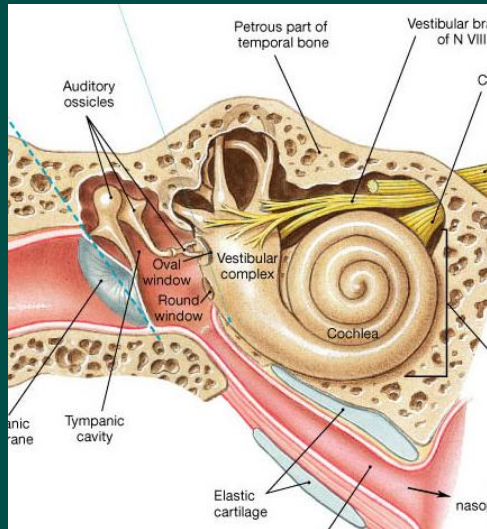
- Tympanic membrane
- Three Auditory Ossicles
  - Incus, Malleus Stapes
- Transmit Vibrations to Inner Ear
- **Eustachian Tube** = Auditory Tube = Pharyngotympanic Tube



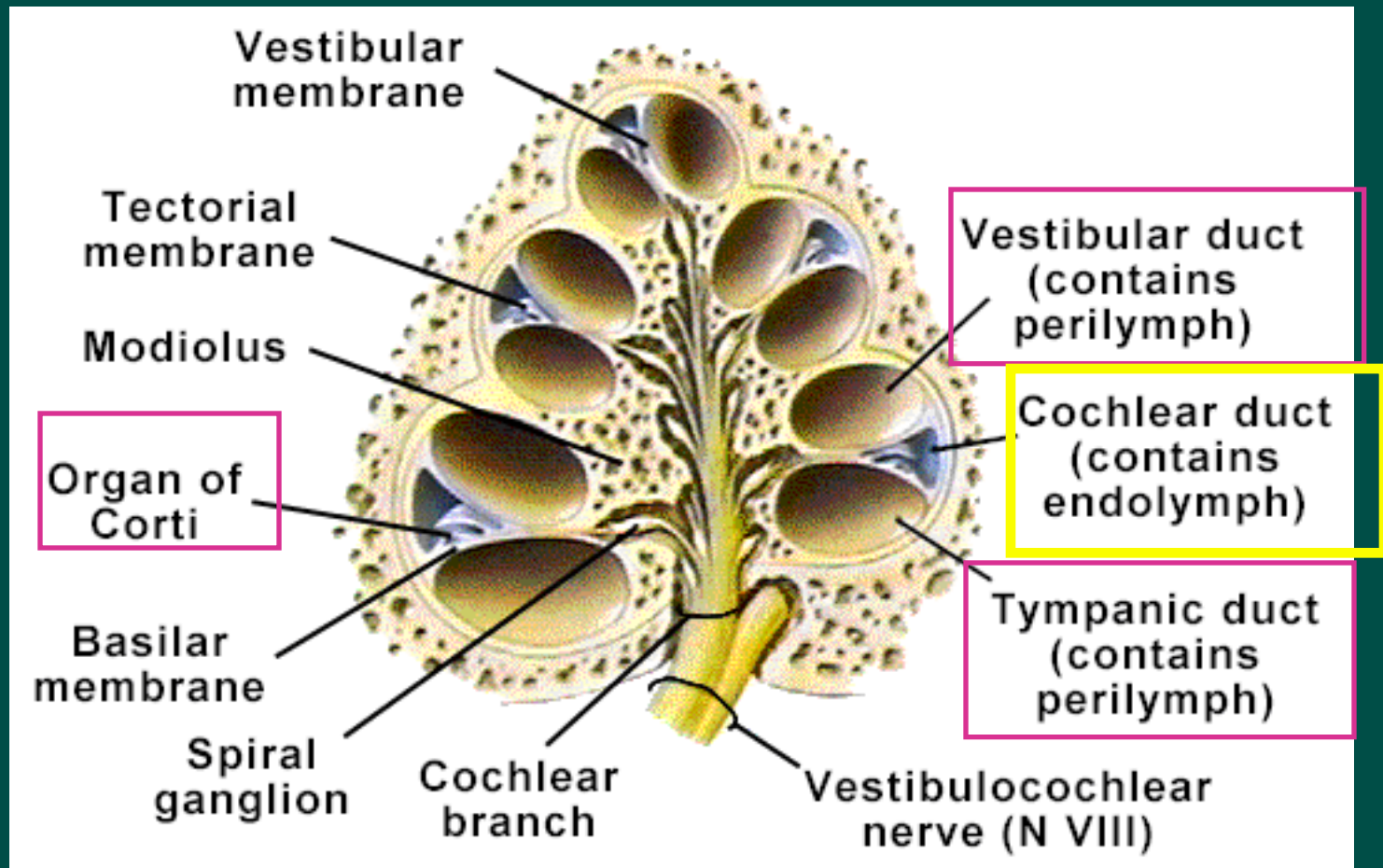
**Otitis media**

# 3. Inner Ear

- Cochlea
- Vestibular complex



# Structure of cochlea: 2.5 turns of ducts

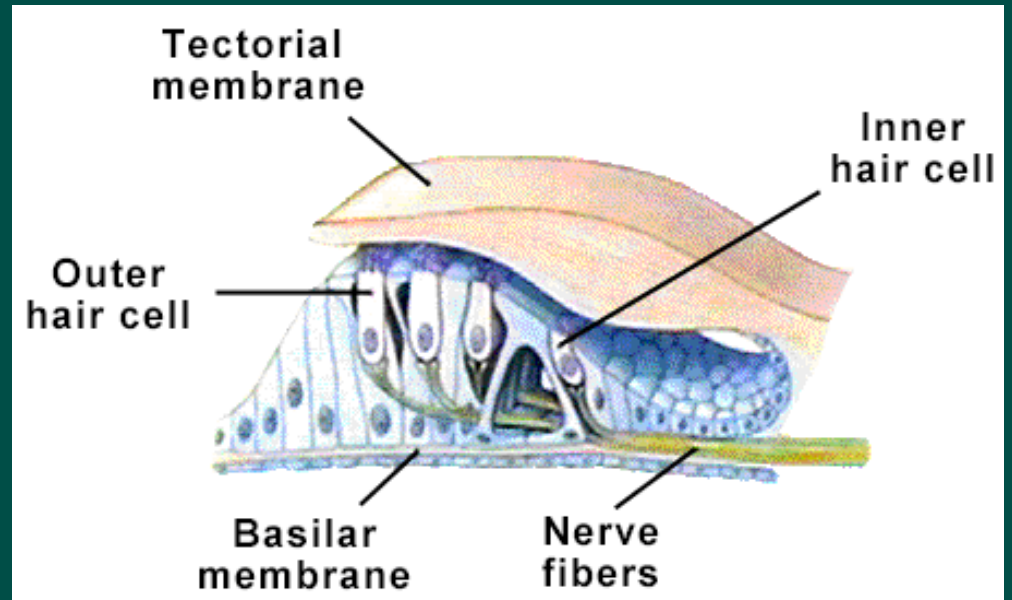
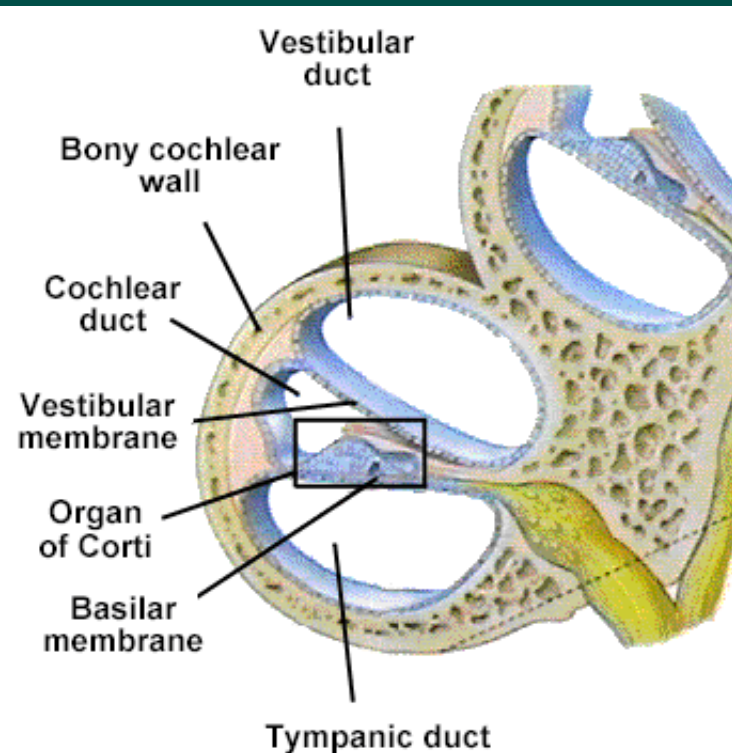


# Organ of Corti

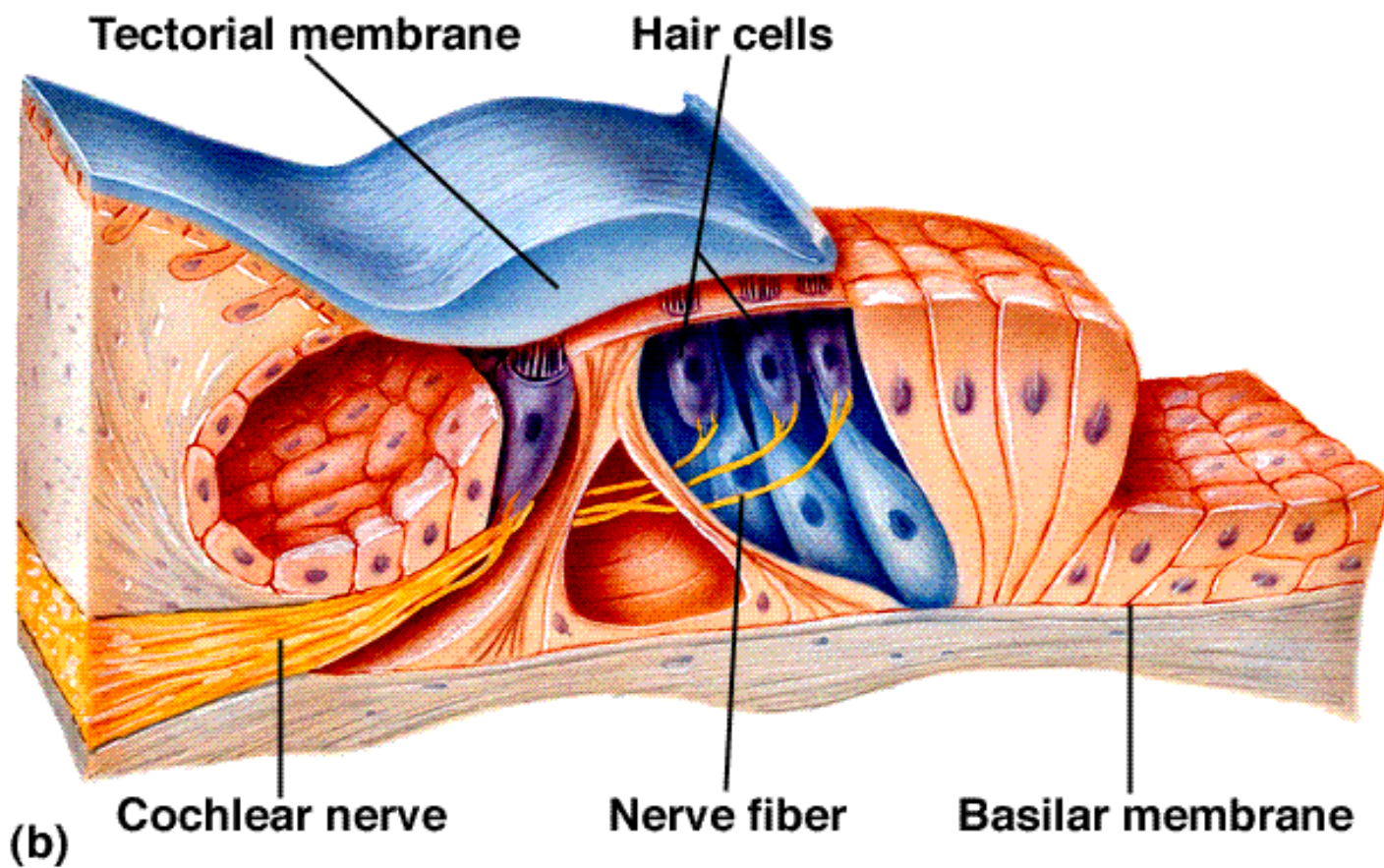
Basilar membrane on which sit hair cells with stereocilia

Tectorial membrane above the hair cells

Sound causes hair cells to bounce and touch tectorial membrane causing transduction

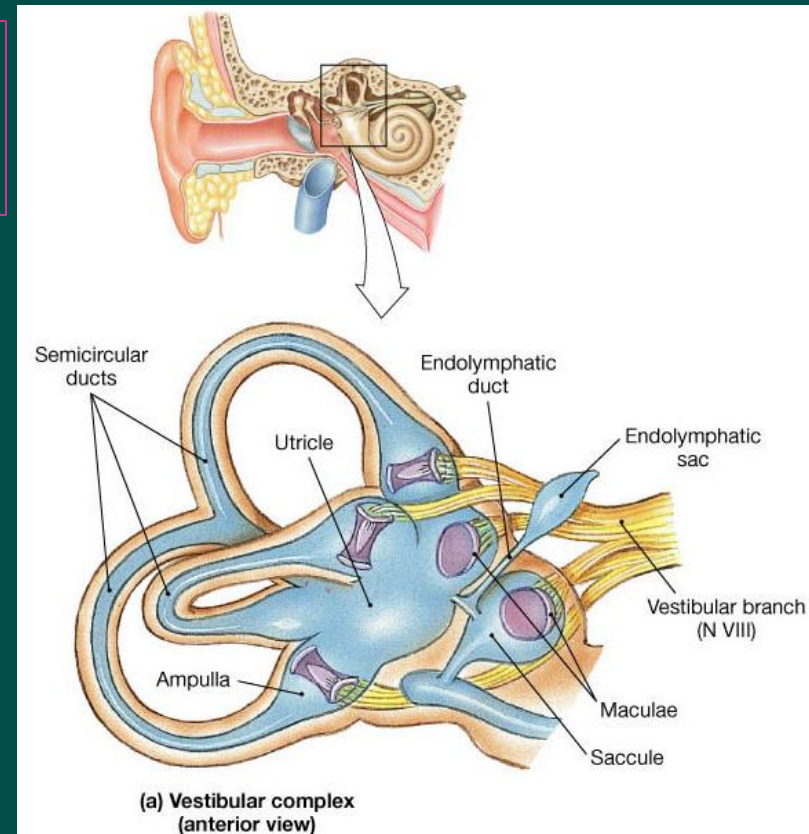


# Organ of Corti



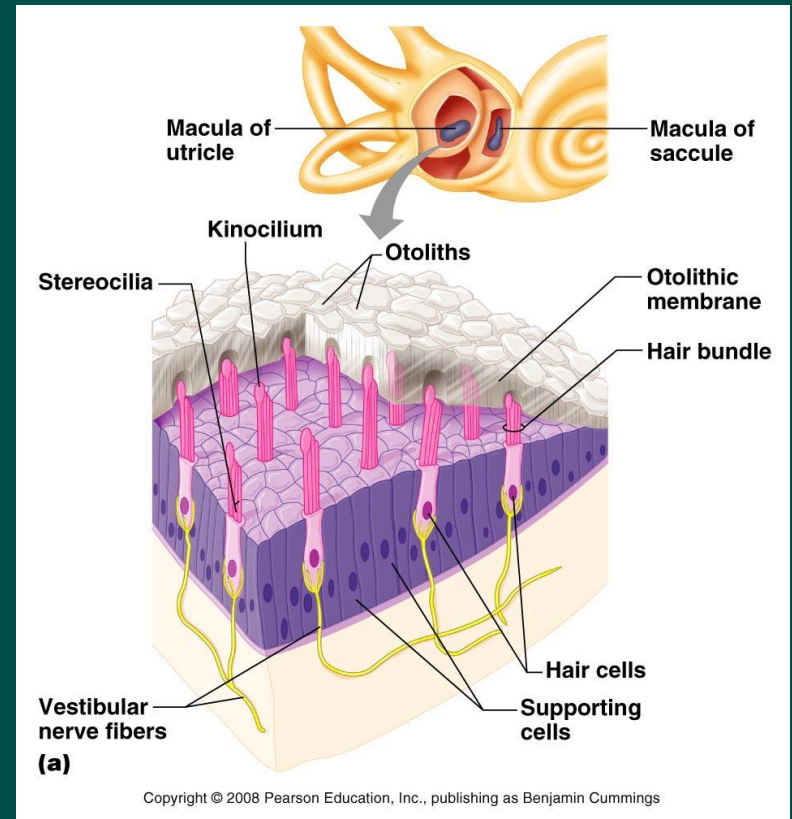
# Vestibular Complex

- Vestibule
    - Saccule
    - Utricle
  - Static equilibrium
  - Three **semicircular canals** with ampullae (mutually perpendicular)
  - Linear acceleration
- Each has a macula with receptors



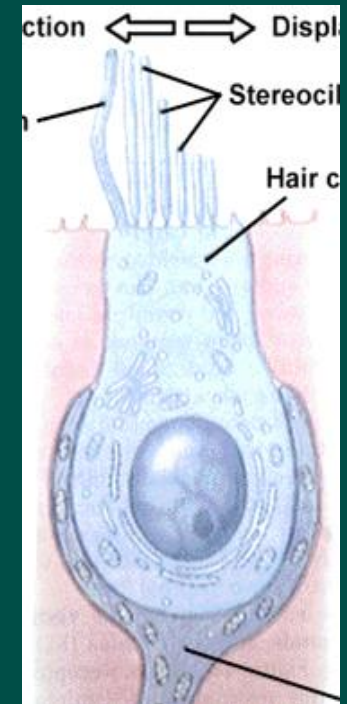
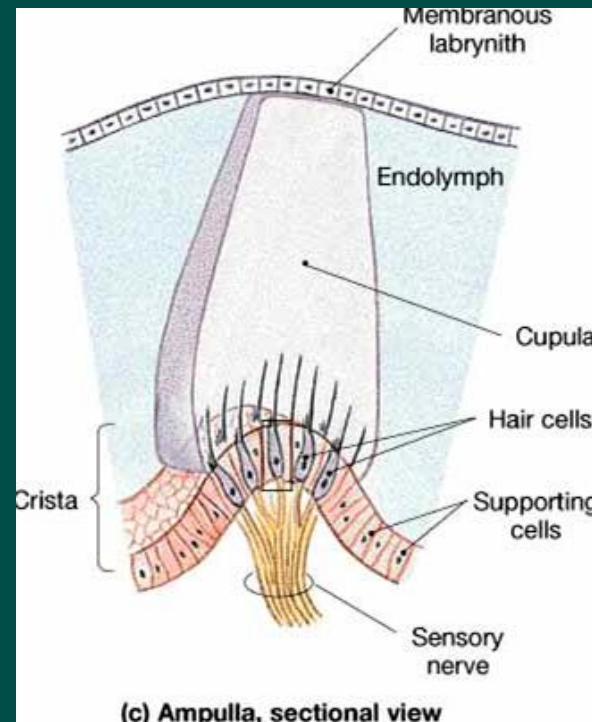
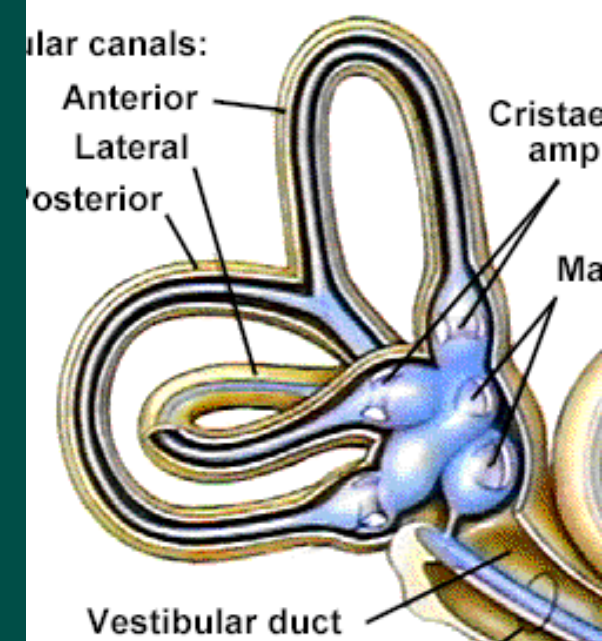
# Two Receptor Organs of vestibule

- Two Maculae
  - or: macula of saccule plus macula of utricle
  - Vertical and horizontal orientation
  - Contain otoliths that move according to gravity
  - Hair cells conduct impulse to CN VIII



# Semicircular Canals

- Oriented perpendicular
  - Anterior
  - Posterior
  - Lateral
- Each has an ampulla
  - Crista ampullaris bends



# Auditory Pathway

## Cochlear branch of CN VIII

From cochlea:

To cochlear nucleus of medulla

Decussation

To inferior colliculus of opposite side of midbrain

To thalamus

To auditory cortex

